H_2O *vs.* D_2O: THERMODYNAMICS BEYOND NMR

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Hydrogen bonding plays a crucial role in water structuring. Due to disruption of the strong hydrogen bond network, solvation of non-polar species (and surfaces) is thermodynamically unfavorable. This leads to a significant affinity of macrocyclic receptors (e.g., cucurbiturils (CBs) and cyclodextrins (CDs)) towards hydrophobic species in water. Recent studies have shown that dehydration of the guest and the host cavity are the main driving forces for hydrophobically driven inclusion. In these systems, high complex stability is usually due to favorable complexation enthalpy, commonly ascribed to cavity dehydration and the reestablishment of bulk water hydrogen bonds. Since the latter are known to be stronger in D_2O versus H_2O, a considerable impact on the complexation thermodynamics is to be expected in these cases. However, the inclusion complex stability constants for these systems are usually assessed by ^1H NMR spectroscopy in D_2O which does not provide information on the possible isotope effect on the enthalpic and entropic contribution to the reaction Gibbs energy. Therefore, we have systematically explored the difference in binding affinities of various CBs and CDs with hydrophobic guests in H_2O and D_2O by means of ITC in a wider temperature range (5–65 °C). The obtained results were discussed based on the structure of hosts and guests, as well as the possible influence of the differences in H_2O and D_2O structuring and related hydration and physical properties. The obtained results provide important insights into the isotope effects on the complexation thermodynamics in protic solvents with variable protium and deuterium abundance.

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REFERENCES

[1] F. Biedermann and W. M. Nau, H.-J. Schneider, *Angew. Chem. Int. Ed.* **2014**, 53, 2–16.

[2] M. V. Rekharsky and Y. Inoue*, Chem. Rev.* **1998**, 98, 1875−1917.

[3] D. Sigwalt, M. Šekutor, L. Cao, P. Y. Zavalij, J. Hostaš, H. Ajani, P. Hobza, K. Mlinarić-Majerski, R. Glaser and L. Isaacs, *J. Am. Chem. Soc.* **2017**, 139, 3249−3258.